In the Claims

Applicant submits the new complete claim set, as shown below:

Please cancel claims 12-16, 18-22, 24-27, 29, 32-35, 37-42, 44-50, and 52-55 without prejudice or disclaimer.

1. (Original) An apparatus for positioning a polymer in a microchannel, which comprises:

a microchannel having first and second ends and substantially opposed sidewalls, the microchannel being constructed and arranged to transport a polymer carrier fluid such that, when present, the polymer flows from the first end toward the second end in a laminar flow stream;

a first section of the microchannel disposed between the first and second ends of the microchannel, the substantially opposed sidewalls of the first section constructed and arranged to create a first velocity gradient in the flow stream passing there through;

opposed flow control channels in fluid communication with the microchannel, the flow channels being positioned between the first section and the second end of the microchannel;

a flow controller to control the flow of fluid through the opposed flow control channels to maintain the flow stream containing the polymer in a laminar state isolated from the substantially opposed sidewalls of the microchannel at points downstream from the opposed flow control channels;

a second section of the microchannel disposed between the opposed flow control channels and the second end of the microchannel, the substantially opposed sidewalls of the second section being constructed and arranged to create a second velocity gradient in the flow stream passing there through; and

a detection zone disposed within the microchannel.

2. (Original) The apparatus of claim 1 wherein the flow controller is adapted to move the polymer into the detection zone.

3. (Original) The apparatus of claim 1 wherein the flow controller comprises at least two flow controllers, each of the at least two controllers for independently controlling the flow of fluid through each of the opposed flow control channels.

4. (Original) The apparatus of claim 1 wherein the flow controller comprises a pressure source.

5. (Original) The apparatus of claim 1 wherein the substantially opposed sidewalls of the first section are substantially non-parallel.

6. (Original) The apparatus of claim 5 wherein the substantially opposed sidewalls of the second section are substantially non-parallel.

7. (Original) The apparatus of claim 1 wherein the second velocity gradient ends upstream of the detection zone by at least a distance equal to the polymer.

8. (Original) The apparatus of claim 6 wherein the polymer is DNA.

9. (Original) The apparatus of claim 7 wherein the polymer is RNA.

10. (Original) The apparatus of claim 7 adapted to create a fluidic boundary between the carrier fluid an the flow through the opposed flow control channels wherein the opposed flow controller is further adapted to control a shape of the fluidic boundary.

11. (Original) A method of positioning a polymer within a microchannel, the method comprising:

providing a polymer positioning apparatus comprising:

a microchannel having first and second ends and substantially opposed sidewalls, the microchannel being constructed and arranged to transport a polymer carrier fluid such that, when present, the polymer flows from the first end toward the second end in a laminar flow stream;

a first section of the microchannel disposed between the first and second ends of the microchannel, the substantially opposed sidewalls of the first section constructed and arranged to create a first velocity gradient in the flow stream passing there through;

opposed flow control channels in fluid communication with the microchannel, the flow channels being positioned between the first section and the second end of the microchannel;

a flow controller to control the flow of fluid through the opposed flow control channels to maintain the flow stream containing the polymer in a laminar state isolated from the substantially opposed sidewalls of the microchannel at points downstream from the opposed flow control channels; and

a second section of the microchannel disposed between the opposed flow control channels and the second end of the microchannel, the substantially opposed sidewalls of the second section being constructed and arranged to create a second velocity gradient in the flow stream passing there through;

providing a polymer carrier fluid containing a polymer into the microchannel; and

manipulating the flow controller for selectively positioning the polymer within the microchannel.

12-16. (Canceled)

17. (Original) A method of focusing a polymer within a microchannel, the method comprising:

providing a carrier fluid containing a polymer to a microchannel adapted to deliver the carrier fluid from a first end of the microchannel to a second end of the microchannel;

focusing the carrier fluid in a first velocity gradient created by a first set of substantially opposed walls of the microchannel; then

focusing the carrier fluid in a second velocity gradient created by a side flow of fluid entering the microchannel; and then

focusing the carrier fluid in a third velocity gradient created by a second set of substantially opposed walls of the microchannel.

18-22. (Canceled)

23. (Original) An apparatus for elongating a polymer which comprises:

a microchannel having first and second end, a polymer elongation zone, and opposed sidewalls, the microchannel being constructed and arranged to transport a polymer carrier fluid such that, when present, the polymer flows from the first end toward the polymer elongation zone in a laminar flow stream;

opposed flow control channels in fluid communication with the microchannel through the opposed sidewalls, the flow control channels being positioned between the first end of the microchannel and the polymer elongation zone;

opposed polymer control channels in fluid communication with the microchannel through the opposed sidewalls, the polymer control channels defining the polymer elongation zone and being positioned between the opposed flow control channels and the second end of the microchannel;

a first end fluid controller for directing a fluid through the microchannel from the first end toward the polymer elongation zone;

an opposed flow controller for controlling the flow of fluid through the opposed flow control channels to maintain the flow stream containing the polymer in a laminar state isolated from the opposed sidewalls of the microchannel;

an opposed polymer channel controller for controlling the flow of fluid through the opposed polymer control channels, and

a second end flow controller for directing fluid through the microchannel from the second end toward the polymer elongation zone.

24-27. (Canceled)

28. (Original) A method for elongating a polymer which comprises:

providing a polymer elongation apparatus comprising:

a microchannel having a first end, a polymer elongation zone, and opposed sidewalls, the microchannel being constructed and arranged to transport

a polymer carrier fluid such that, when present, the polymer flows from the first end toward the polymer elongation zone in a laminar flow stream;

opposed flow control channels in fluid communication with the microchannel through the opposed sidewalls, the flow control channels being positioned between the first end of the microchannel and the polymer elongation zone;

opposed polymer control channels in fluid communication with the microchannel through the opposed sidewalls, the polymer control channels defining the polymer elongation zone and being positioned between the opposed flow control channels and the second end of the microchannel;

an opposed flow controller for controlling the flow of fluid through the opposed flow control channels to maintain the flow stream containing the polymer in a laminar state isolated from the opposed sidewalls of the microchannel; and

an opposed polymer channel controller for controlling the flow of fluid through the opposed polymer control channels

directing a fluid carrier containing the polymer to be elongated through the microchannel from the first end toward the polymer elongation zone in a laminar flow stream; and

directing a flow control fluid through the opposed flow control channels into the microchannel in a manner such that polymer-containing flow stream is isolated from the sidewalls of the microchannel.

29. (Canceled)

30. (Original) An apparatus for maintaining a polymer in an elongated configuration which comprises:

a microchannel constructed and arranged to contain a polymer in a carrier fluid, the microchannel having opposed sidewalls defining a first microchannel width, a second microchannel width, smaller than the first width, and a transition between the first and second microchannel widths;

wherein the transition adapted to contact and inhibit relaxation of an elongated polymer contained within the first microchannel width.

31. (Original) An apparatus for elongating a polymer and maintaining it in an aligned or elongated configuration the apparatus comprising:

a microchannel having first and second ends, a polymer elongation zone, and opposing sidewalls, the microchannel being constructed and arranged to transport a polymer in a carrier fluid such that, when present, the polymer flows from the first end toward the polymer elongation zone in a laminar flow stream;

opposed polymer control channels in fluid communication with the microchannel through the opposing sidewalls, the polymer control channels adapted to provide a flow of fluid for defining the polymer elongation zone, the polymer control channels positioned between the first end and the second end of the microchannel, wherein at least one of the polymer control channels includes at least one transition to a narrower microchannel width, the transition for contacting and inhibiting relaxation of an elongated or aligned polymer contained in the narrower width, and further wherein at least one of the polymer control channels includes at least one serpentine bend to cause at least one portion of the polymer control channel to be located adjacent and parallel to another portion of the polymer control channel;

a first end fluid controller for directing a fluid through the microchannel from the first end toward the polymer elongation zone;

an opposed polymer channel controller for controlling the flow of fluid through the opposed polymer control channels; and

a second end fluid controller for directing fluid through the microchannel from the second end toward the polymer elongation zone.

32-35. (Canceled)

36. (Original) An apparatus for detecting a polymer comprising:

a microchannel having first and second ends;

an obstacle field arranged between the first and second ends at the microchannel, the microchannel being constructed and arranged to transport the polymer in a carrier fluid such that,

when present, the polymer flows from the first end, through the obstacle field and toward the second end in a laminar flow; and

a detection zone located in the obstacle field, the detection zone for detecting the polymer.

37-42. (Canceled)

43. (Original) A method for detecting a polymer which comprises:

providing an apparatus comprising a microchannel having first and second ends and an obstacle field between the first and second ends, the microchannel being constructed and arranged to transport the polymer in a carrier fluid such that, when present, the polymer flows from the first end, through the obstacle field and toward the second end in a laminar flow;

providing a polymer carrier fluid containing a polymer to be detected;

flowing the polymer in the carrier fluid through the obstacle field in a manner such that at least one polymer becomes transiently tethered to at least one obstacle comprising the obstacle field; and

detecting the transiently tethered polymer.

44-50. (Canceled)

51. (Original) An apparatus for holding a polymer on a microchip, the apparatus comprising:

a microchannel disposed on the microchip, the microchannel having a first end and a second end and opposing sidewalls, the microchannel being constructed and arranged to transport a polymer in a carrier fluid, such that, when present, the polymer flows from the first end toward the second end along a flow path;

the microchannel being arranged on the microchip with a first bend causing a first portion of the microchannel to be located adjacent to and aligned with a second portion of the microchannel.

52-55. (Canceled)